

Text-Signaling Devices and Their Effects on Reading and Memory Processes

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Signals are writing devices that emphasize aspects of a text's content or structure without adding to the content of the text. Findings are reviewed for studies of several different types of signaling devices, including: titles, headings, previews, overviews, summaries, typographical cues, recall sentences, number signals, importance indicators, and summary indicators. Most investigations have examined how the presence of signals in a text affects subsequent memory for the text. Virtually all types of signals produce better memory for information they cue in a text, whereas memory for unsignaled information often is unaffected. Less attention has been directed to signaling effects on other cognitive processes, such as attention, basic reading processes, and comprehension. It is argued that an understanding of how signals influence these processes will contribute to the application of signaling research to reading and writing instruction and to our general understanding of reading.

KEY WORDS: signals; writing devices; writing instructions; reading.

TEXT SIGNALING DEVICES AND THEIR EFFECTS ON READING AND MEMORY PROCESSES

Imagine picking up an introductory textbook in psychology and finding the author has made no attempt to distinguish important from unimportant information. The book has no chapter breaks, no headings, no indentations, no variations in typeface or color, no summaries or overviews, nor any other devices to direct your attention to the most relevant aspects of content and organization. The text would still be completely coherent, but

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the task of learning its subject matter would be less interesting and more difficult than necessary.

The author of an expository text has the goal of communicating a body of knowledge or a set of arguments as effectively as possible. To do this, authors typically use a variety of *signaling devices* intended to help readers identify and remember the text's main points. Educational psychologists have examined some of the effects of different signaling devices on reading and memory processes. The purposes of this review are to summarize those empirical findings, point out the deficiencies in our current understanding of how signals influence reading, and provide a framework for directing future studies of signaling. The emphasis throughout will be on the effects of signals on cognitive processes associated with reading and memory. The organization of the paper is as follows. First, the topic will be carefully defined. Second, a framework will be proposed for thinking about potential effects of signals on a range of cognitive processes. Third, current empirical findings will be reviewed. Finally, implications for application and future research will be discussed.

A DEFINITION OF SIGNALING

A writer begins with a mental representation of the information to be communicated to an audience. This representation, or "text base" may be conceptualized as a hierarchically organized network of related propositions (Kintsch and van Dijk, 1978). The written text resulting from the writer's text base is the product of many transformations. Some transformations involve translating the text base into a surface representation (i.e., written text) that efficiently communicates the information in the text base. Another category of transformations involves applying various writing devices to direct the reader's attention to specific aspects of the content and organization of the text. Thus, a distinction may be made between those aspects of a written text that communicate the semantic content of the underlying text base vs. signals, which emphasize particular aspects of the content or structure of a text without communicating new semantic content.

The text signals that have received at least some research attention include a diverse collection of writing devices, as is evident in the list presented in Table I. There is one important unifying characteristic of this list, however. All of the devices share the goal of directing the reader's attention during reading. In addition, several of the devices emphasize aspects of text content. Titles and headings label the dominant topic or theme of the subsequent text and thus help guide the reader to the most relevant information in the text. Function and relevance indicators use linguistic pointer devices,

Table I. Signaling Devices in Expository Prose

Titles
Headings and subheadings
Repetition of content, including:
Exact repetition of a statement for emphasis
Certain types of preview statements
Certain types of summary statements
Function indicators, including:
Pointer words (e.g., “thus”)
Pointer phrases (e.g., “in summary”)
Pointer sentences (e.g., “Let me summarize what has been said.”)
Relevance indicators, including:
Pointer phrases or statements emphasizing particular content (e.g., “Let me stress that . . .”)
Enumeration devices (e.g., numbering points in an argument)
Typographical cues, including:
Underlining
Change of appearance of print (e.g., boldface, color)
Distinguishing content spatially (e.g. indentation, centering)

and typographical cues use print variations to tag very specific content as important. Previews, overviews, and summaries employ repetition to emphasize specific content. Finally, several of the devices may be used to make aspects of a text’s organization more explicit. These devices include headings, previews, overviews, summaries, and enumeration devices.²

²In her treatment of signaling devices, Meyer (1975) includes the explicit statement of rhetorical predicates and many types of logical connectives. Meyer attempts to distinguish cases where rhetorical predicates and semantic relations are stated explicitly as opposed to implicitly; explicit statements are considered cases of signaling, whereas implicit information does not constitute signaling. However, it is difficult to see how these devices can be considered “non-content aspects of prose” when their primary function appears to be the explicit communication of the semantic content of the text base. It also is unclear in what sense they are intended to direct a reader’s attention. Certainly, these two categories of writing devices are qualitatively different from the devices listed in Table I. There is one instructive indication of the difference between the devices in Table I, on the one hand, and statements of rhetorical devices and logical connectives on the other. Namely, an investigator wishing to assess the effects of a particular signaling device often will construct a text with signals and an alternative version without signals. For all of the devices listed in Table I, a text version without signals is typically created by deleting instances of signaling from the with-signaling version of the text. However, simple deletion usually is impossible in the case of logical connectives and explicit statements of rhetorical predicates because incomplete sentences will result. Instead, sections of the text must be re-written to maintain grammatical, cohesive text.

A FRAMEWORK FOR PROGRAMMATIC RESEARCH ON SIGNALING

Although there are several exceptions, the majority of signaling studies have focused on memory effects. The nature of signaling effects on memory and the mechanisms underlying those effects are important issues. However, this emphasis on memory paradigms has been at the expense of important questions concerning signaling effects on reading processes. Therefore, before reviewing the empirical research, a list of five questions is presented to define the domain of issues relevant to this review. The questions are:

1. How is attention during reading affected by signaling?
2. How are components of the reading process affected by signaling?
3. How is comprehension affected by signaling?
4. How is memory affected by signaling?
5. How is selective access to text information affected by signaling?

These five questions represent broad issues raised by different investigators in different contexts (e.g., Goetz *et al.*, 1987; Mayer, 1984; Meyer, 1975). They represent a programmatic approach to considering signaling research that will: (1) Provide a context for evaluating the findings with respect to each category of signaling device to be reviewed; and (2) facilitate identification of similarities and differences in how various signaling devices affect reading and memory processes. If we can answer these questions for a particular signaling device, we will have achieved a good understanding of that device. If we can answer these questions for every signaling device, we will have achieved a relatively complete understanding of the relationships among different signaling devices. Before I review the empirical literature and attempt to answer these questions, allow me to expand on each of the questions.

Table II summarizes the five potential loci of signaling effects and associated procedures for investigation. These five potential effects of signals

Table II. Paradigms for Investigating the Nature of Signaling Effects

Locus	Paradigm
Attention	Reading time (RT) on signaled information
	Eye movements to signaled information
	RT to secondary probe while reading signaled information
Reading process	Average reading time
	Average RT in a secondary probe task
	Outcome measures following reading under time pressure
Comprehension	Inference from text information
	Problem-solving in analogous situations
Memory	Recognition test
	Cued recall
	Free recall
Selective Access	Text search tasks; latency and accuracy on specific inquiries of text content

probably are not the only effects that might be identified, but they represent a broad range of possible influences. It is likely these effects, where observed, will be interrelated. It may well be, for example, that most effects on reading processes, comprehension, and memory are mediated by effects on attention. However, it is theoretically possible to distinguish these different loci of effects and it probably is prudent to do so. That way there is less risk of overlooking important differences in the effects and operations of different signaling devices.

One potential locus of signaling effects on cognitive processing is attention. In fact, all signals attempt to direct readers' attention to specific information in a text. Whether a given type of signal is effective in directing attention, however, is an empirical issue. Investigators have frequently inferred effects on attention based on indirect measures (e.g., recall). However, a direct test of attentional effects must assess the influence of the signal at the time it is encountered during reading. One procedure is to measure whether reading speed on specific information in a text is affected by the presence of a signal (Lorch and Chen, 1986; Lorch and Lorch, 1986). Alternatively, eye movements might be studied. Yet another procedure is to observe whether the latency to respond to a secondary probe stimulus is influenced by whether the sentence a reader is processing is signaled or unsignaled.

A second potential effect of signaling is to facilitate specific cognitive processes occurring during reading. For example, a reader must discriminate important from unimportant information while reading. A reader also must comprehend the organization of related information in a text. Signals can be employed to explicitly mark both important information and text organization, thus simplifying some of the decisions (e.g., about relevance) and reducing the number of inferences (e.g., about relations in the text) readers otherwise would have to make in order to fully comprehend the text (Goetz *et al.*, 1987). Such potential facilitating effects of signals on the reading process may be manifested in a laboratory tasks as faster reading or as faster responding in a secondary probe task (e.g., Britton *et al.*, 1982).

A third potential effect of signaling is on the reader's ultimate comprehension of text information. In the absence of signaling, readers may fail to note important content or aspects of text organization and comprehension may suffer. Effects on comprehension have been examined using problem-solving tasks based on text content (Loman and Mayer, 1983; Mayer *et al.*, 1984). Other procedures might involve requiring a reader to make inferences from text content with the text still available to the reader (in order to separate signaling effects on comprehension from effects on memory).

Fourth, signaling may influence memory for text. Signals distinguish specific text content as important, thus they produce better memory for the information they cue in a manner similar to the von Restorff effect found

in list-learning experiments (Wallace, 1965). Signaling effects on text memory have been studied using various recognition, cued recall, and free-recall tasks.

Fifth, a potentially important function of some types of signals is to direct selective access between and within texts (Waller, 1979, 1980). Readers use titles to help determine whether a text is relevant to their interests. Headings also can inform readers of the relevance of a text or can guide a search for specific information within a text. Selectively accessing specific information in a text is an important reading skill (Guthrie, 1988; Kirsch and Guthrie, 1984) and signals are well-suited to facilitate such processing. The function of signals in directing selective access to text information might be investigated by measuring the latency and accuracy of subjects' responses to specific inquiries for information from a previously unread text (Hartley and Trueman, 1985).

SIGNALING EFFECTS ON READING AND MEMORY

In this section, the nature of signaling effects on reading and memory will be reviewed. The section is divided into subsections that present findings with respect to titles, headings, previews, overviews and summaries, typographical cues, and other devices. For each device, I consider its effects on attention, basic reading processes, comprehension, memory, and selective access to information in a text. I also speculate about potential effects that have not yet been investigated.

Titles

A title is the initial linguistic information provided in a text. Titles invariably are distinguished from the body of the subsequent text both by their spatial location and typeface. In an expository text, a title typically states the major topic or theme of the text. Thus, a title signals particular text content as relevant; it does not convey information about text organization. The "scope" of a title is the entire text, which may range from a paragraph to a book³ The relation between a title and particular text content often is difficult to specify. Sometimes the subject of a sentence explicitly refers to a topic labeled by the title. In this case, it is clear the sentence conveys information signaled by the title. More generally, however, determination of the relation between a title and specific text content necessitates representing the semantic content of the text (e.g., Kintsch and van Dijk, 1978; Meyer, 1975).

³The term "scope" refers to the amount of text marked as relevant by a signal. The scope of a signal can range from a single word, distinguished by underlining, to an entire text, as in the case of a title.

This poses problems both for the researcher and the reader. The researcher must represent the text content carefully in order to specify what information in the text is signaled by the title (cf., Koziminsky, 1977). Similarly, the reader must comprehend the text content (i.e., represent it) in order to determine what statements are relevant, as signaled by the title.

Almost all of the available research on titles has employed memory paradigms to investigate their effects. Therefore, I begin by reviewing this work, then consider how other paradigms might contribute further to an understanding of how titles influence reading and recall.

Titles provide a context for the interpretation of subsequent text. One way they provide context is by indicating knowledge structures relevant to the interpretation of the text. For example, a prospective reader of this article knows from the title alone that background knowledge on both reading and memory processes will be helpful in understanding the article, whereas knowledge of particle physics probably will be irrelevant. This function of titles may aid readers in two related ways: by clarifying potentially ambiguous referents in the text, and by suggesting familiar knowledge structures that may be used to integrate text information into memory. There is evidence titles do, indeed, serve these purposes. Several investigators have examined the effects of titles on memory for brief texts whose referents are metaphorical or very abstract (Bransford and Johnson, 1972; Dooling and Lachman, 1971; Dooling and Mullet, 1973). In each study, subjects received texts either without a title or with a thematic title presented before the text. The thematic title clarified the referents of the text by identifying the text as a description of a familiar event (e.g., Columbus' discovery of America) or procedure (e.g., washing clothes). In all cases, free recall was better when a title was provided before the text was read than when the title followed the text or no title was presented (Bransford and Johnson, 1972; Dooling and Mullet, 1973). This finding suggests titles do not aid recall simply by providing a retrieval cue; rather, titles indicate relevant knowledge structures for organizing and integrating statements in a text which, in turn, benefits recall.

The referents in most texts are relatively concrete. Further, the appropriate background knowledge for interpreting most texts is inferred easily from the text content. When these conditions hold, there is little or no effect of titles on the amount of information remembered from a text (Hartley *et al.*, 1980; Koziminsky, 1977; Schallert, 1976; Yuill and Joscelyne, 1988). There are selective effects on what is remembered, however. Titles designate some text content as more relevant than other content. If titles cause readers to process content selectively, one would expect to find differential memory for title-relevant vs. title-irrelevant information. There are several demonstrations of such selectivity. When readers are presented texts written to be ambiguous with respect to two potential topics, their memories are biased toward

the topic signaled by the title (Bock, 1980; Kozminsky, 1977; Schallert, 1976). Similarly, when presented a text whose referents are unclear, readers demonstrate better recognition of highly thematic words from the text if the text is preceded by a title than if there is no title; however, there is no influence of the title on recognition of low thematic words or content words (Dooling and Lachman, 1971).

In sum, studies of text memory suggest that a title guides a reader's processing of a text by indicating relevant background knowledge to which text information might be related, and by indicating the relevance of text statements via labeling of the central topic or theme of the text. Studies using other paradigms would be useful to elucidate the mechanisms by which titles influence memory. In the case of texts whose referents are unclear, comprehension difficulties may well mediate the observed effects on memory. Subjects certainly perceive themselves as not understanding such texts very well (Bransford and Johnson, 1972). This hypothesis implies the reading process should proceed more smoothly if a title is provided than if no title is provided. The demonstration of selective effects on memory suggests titles may influence how readers distribute their attention to information in a text. Perhaps readers attend more closely to statements they perceive as title-relevant than to less relevant statements. Alternatively, a title may influence readers' representation of a text by serving as a superordinate context for text statements. One finding consistent with this hypothesis is that when readers are asked to organize randomly sequenced sentences from a story with two alternative themes, they produce different sentence orderings depending upon the title they are presented for the story. Further, the serial position of a sentence in the ordering they produce correlates with the rated semantic distance of the sentence from the title (Bock, 1980).

Headings

Headings demarcate distinct subsections of a text. They almost invariably are distinguished spatially and typographically from the body of the text. They always precede the text content they signal and identify aspects of the overall organization of the text. A heading may consist of a single word or phrase naming the topic of the subsequent subsection, or a heading may be a sentence or question conveying the theme of the subsection. By labeling distinct sections of the text, headings signal the organization of a text. By conveying the topic or theme of a section, a heading signals relevant content within the section.

A particular heading operates on the section it labels, and that section can be anywhere from a paragraph to a chapter in length. Thus, the scope

of a heading can vary quite a bit, although it usually is relatively wide. Related to this, the relation between a heading and specific text content can be strong or weak, clear or vague. The problems of specifying relationships between headings and text content are analogous to the problems considered for titles.

Most of the research on headings has studied effects on text memory. Headings may be expected to influence memory in a variety of ways, some of which have been investigated. First, the presence of headings may cause a general improvement in text memory. There is some evidence that information on distinct topics in a text are represented and accessed independently in memory (Lorch and Lorch, 1985). Headings provide an explicit representation of a text's topics and their organization. Thus, they supply the reader with a potential retrieval plan for the topics in a text. If the reader can recall the individual text topics, the information associated with each topic can be accessed and recall should be good. The most direct test of this hypothesis would involve assessing overall text memory with a free-recall task, because free recall places great demands on subjects' abilities to systematically search their memories. Unfortunately, the relevant experiment has not been done. There is some less direct support for the hypothesis, however. Studies using a wide variety of memory measures (i.e. cued recall, recognition, summarization, free recall scored for specific content) consistently have found better memory when headings are present than when they are absent from a text (Brooks *et al.*, 1983; Dee-Lucas and DiVesta, 1980; Doctorow *et al.*, 1978; Hartley *et al.*, 1980; Hartley and Trueman, 1985; Holley *et al.*, 1981). Interestingly, the only studies failing to find any reliable effects of headings on memory performance all have employed recognition memory tests (Christensen and Stordahl, 1955; Klare *et al.*, 1958; Spyridakis and Standal, 1986), which is consistent with findings that recognition memory typically is less influenced than recall by variables affecting memory search processes.

In addition to global effects, headings may be expected to have specific effects on text memory. Headings directly label text topics and implicitly convey the organization of those topics by the location of the headings in the text. Thus, the presence of headings may aid memory for the superordinate content and structure of a text. There is some evidence this is the case. Readers produce better summaries (Brooks *et al.*, 1983) and outlines (Brooks *et al.*, 1983; Dee-Lucas and DiVesta, 1980) if a text includes headings. Also, memory for the main points of a text is improved by the presence of headings (Hartley *et al.*, 1980; Hartley and Trueman, 1985; Spyridakis and Standal, 1987; Wilhite, 1986).

Another potential selective effect of headings is on memory for specific subordinate information. A heading signals some content as more relevant than other content, just as a title differentially cues the relevance of

text content. Dee-Lucas and DiVesta (1980) have demonstrated better memory for attributes of a topic if the topic is signaled by a heading than if no headings are present.

Thus, there is evidence headings facilitate memory for the content and structure they signal. However, it is unclear whether these memory effects are, in fact, selective. Some studies finding better memory for heading-relevant information also have found better memory for other, less relevant information when headings are included in a text (Doctorow *et al.*, 1978; Wilhite, 1986). Future investigations must carefully distinguish between heading-relevant and heading-irrelevant information in order to determine whether headings have selective effects on memory. Related research on the effects of titles certainly suggests headings should have selective effects on memory for content (cf., Kozminsky, 1977; Schallert, 1976).

In addition to their effects on memory, headings facilitate selective access to specific information within a text. Because headings reliably indicate the content of a text's subsection and are visually distinct, they can efficiently direct the attention of a reader who is searching a text for specific information. Although little research has been done regarding this function of headings, the available evidence clearly indicates readers use headings to guide text-search processes. Whether or not readers have read a text, they are faster to locate the answer to a specific question if the text contains headings (Hartley and Trueman, 1985).

No investigations have been reported of the effects of headings on attention, reading processes, or comprehension. It is easy to speculate about how these processes might be influenced by the presence of headings. For example, sophisticated readers may selectively attend to headings as part of a text-previewing strategy in order to determine whether the text is relevant to their purposes, or to get an overview of text content as part of a comprehension strategy. Also, a reader's distribution of attention to information within a section of text may be influenced by the section's heading. Specifically, statements the reader identifies as related to the heading may be more carefully attended than statements not identified as relevant.

By explicitly labeling text topics and their hierarchical structure, headings may facilitate reading and comprehension. Also, by signaling relevant content within a section, the reader may be aided in the tasks of discriminating important from unimportant information (van Dijk, 1979) and in determining the structure of the information within a section. These potential influences of headings may show up either during the reading process or at a subsequent test of comprehension or both. Reading may be facilitated in a general fashion, as measured by either reading speed or indices of the cognitive demands of reading (Britton *et al.*, 1982). Also, comprehension tests requiring demonstration of the ability to abstract important information about content and structure may show beneficial effects of headings.

Before concluding this section, it should be pointed out that researchers have considered other issues besides those of central concern in this review. The issues concern whether the effects of headings depend upon the following: reader ability (Doctorow *et al.*, 1978; Hartley *et al.*, 1980; Hartley and Trueman, 1985; Klare *et al.*, 1958); developmental level of the reader (Hartley and Trueman, 1985); text difficulty (Spyridakis and Standal, 1986, 1987); location of headings (Hartley and Trueman, 1985); form of headings (Doctorow *et al.*, 1978; Hartley *et al.*, 1980, 1981; Hartley and Trueman, 1985); or time of testing (Brooks *et al.*, 1983; Hartley *et al.*, 1980, 1981; Holley *et al.*, 1981). These issues are important, but unresolved. Current evidence either demonstrates unreliable effects or inconsistent effects with respect to all of these issues.

In sum, it is not presently possible to draw many definitive conclusions concerning the effect of headings on reading and memory processes. There has been virtually no research on the effects of headings on attention, reading processes, or comprehension. The great majority of the relevant studies have employed memory measures. These studies have varied greatly in several respects, including the precise nature of the memory measures, the length and difficulty of the texts, and the subjects' ages. In addition, most investigators have failed to adequately specify the nature of the texts and headings they used as stimulus materials, or the nature of the relation between the headings and the text content or structure tested by their dependent variables. Thus, it is not surprising that the research on headings supports only two general conclusions unambiguously. First, the presence of headings in a text modestly aids memory for the text. Second, the presence of headings facilitates the search for specific information relevant to the headings.

Previews, Overviews, and Summaries

There are close relationships among overviews, previews, and summaries. Overviews and previews both signal upcoming information, emphasizing major topics and aspects of topic organization. Overviews differ from previews in that they anticipate larger sections of the upcoming text. In the research to be evaluated, overviews always preview information across the entire text and previews operate on single paragraphs or pairs of paragraphs.

Overviews and summaries also share several characteristics. First, both devices usually are part of the body of the text, although either may be visually distinguished from the rest of the text (e.g., abstracts of journal articles). Second, overviews and summaries usually operate over entire texts or large sections of text, although this is not a necessary characteristic of either. Summaries, especially, sometimes are written for individual paragraphs. In the research to be reviewed, however, summaries always operate over the entire

text. Third, both devices can be used to emphasize content, organization, or both. One type of summary or overview states the major text topics and their organization. For example, the overview in the second paragraph of this article states the major text topics and their order of discussion. An alternative type of summary or overview places relatively more emphasis on content by abstracting the main ideas of the text. Thus, it emphasizes the major predications concerning the text topics, although it necessarily carries information about what those topics are and how they are organized. Although both overviews and summaries may either list topics or abstract main ideas, topic lists probably are more typical of overviews and main idea abstracts probably are more typical of summaries. Finally, this difference in the prototypical overview and summary is associated with the defining distinction between the two devices; namely, an overview precedes the information it signals, whereas a summary follows the information it signals. Overviews often just list topics because the reader is assumed to lack the prerequisite information to fully comprehend the main ideas in the text. Summaries typically are employed to abstract main ideas because they represent the core content and the reader is assumed to have the prerequisite information to comprehend the ideas after reading the relevant text.

Overviews and previews have been found to influence reading and recall in a variety of ways. Overviews aid readers by making explicit information that otherwise would have to be inferred during reading. In the absence of an overview, readers must identify major text topics as they are introduced and determine how the topics are related. An overview identifies the topics and their organization for the reader. This helps the reader in at least two ways. First, it relieves the reader from inferring the text's topic structure from the topic-introducing sentences in the text. This function of overviews is evident in the finding that the topic sentences of a text are read more quickly if the initial paragraph of the text provides an overview of the topics than if no overview is given (Lorch *et al.*, 1985). Second, a representation of the topic structure of the text provides a plan for the retrieval of information about the text. A complete and organized representation of the text's topics will facilitate memory for the topics and consequently will make information about each topic more accessible. If a text is well-organized or particularly easy for the reader, then readers will have no difficulty representing the text's topic structure in the absence of an overview. However, if a text is difficult to understand or poorly organized, an overview should provide readers with a more coherent representation of the topic structure than they would otherwise be able to construct. Consistent with this hypothesized function, overviews have been found to produce better free recall of texts that are relatively difficult to understand (McGlaughlin-Cook, 1981) or poorly organized (Frase, 1969; Lorch and Lorch, 1985). Further, there is evidence that the effects on

overall recall are directly mediated by effects on recall of topics. Specifically, providing an overview affects the number of different text topics about which information is recalled, but not the amount of subordinate information recalled about each remembered topic (Lorch and Lorch, 1985). In sum, overviews provide readers with a concise statement of the topic structure of the text thus relieving them from inferring this information from the text and providing them with a coherent plan for retrieving information from memory.

A third way in which overviews may influence memory for text is by signaling the main ideas of the text. If an overview consists of an abstract of the text's main ideas, the reader is relieved of the responsibility of discriminating the main ideas from the minor details in the text. This should selectively aid memory for the main ideas, both by guaranteeing that the important information is recognized as such and by directing the reader's attention to the relevant information. In a series of experiments, Hartley and Trueman (1982; Hartley *et al.*, 1979) investigated whether main ideas are better remembered if an overview is presented. Although the effect was not always statistically reliable, they found a consistent trend for better cued recall of main ideas if an overview summarized the main ideas than if no overview was presented; however, there was no difference between the two conditions with respect to recall of information not relevant to the overview. Across four experiments (Hartley and Trueman, 1982, Experiments 1-4), recall of main ideas was 7% higher when an overview was included than when there was no overview. A similar effect has been reported for preview statements. Text content signaled by a preview statement is remembered better than un-signaled text content (Glover *et al.*, 1988; see also, Spyridakis and Standal, 1986, 1987).⁴ Related to this, previews can influence memory for relationships they signal in a text. Glover *et al.* (1988) found that signaling of a relation between two paragraphs via a preview statement caused clustering of the corresponding content in recall. Finally, both effects of preview statements on recall appear to be mediated by effects on attention during reading: Glover *et al.* (1988) demonstrated readers spend more time processing a paragraph if it is signaled by a preview statement than if it is not signaled.

In sum, the following picture seems to be emerging from research on overviews and previews. An overview of a text communicates the major text topics and their organization. This facilitates the reading process by reliev-

⁴Spyridakis and Standal (1986, 1987) employed preview statements which were not redundant with other text content. Their preview sentences often were topic-introducing statements that provided superordinate information elaborated upon in the subsequent paragraph. The references are provided for the interested reader, but the studies are not considered directly relevant to current considerations.

ing readers of the necessity to infer the text's topic structure as topic-introducing sentences are encountered (Lorch *et al.*, 1985). Further, it provides the reader with a coherent statement of the topic structure that can serve as a retrieval plan for text information in memory (Lorch and Lorch, 1985). If the overview or preview signals specific ideas or relationships in the text, the corresponding information is identified for the reader as important with the consequences that it is more carefully attended (Glover *et al.*, 1988) and better recalled (Glover *et al.*, 1988; Hartley and Trueman, 1982) than unsignaled information. While this summary seems a plausible model of how overviews and previews function, it must be considered tentative at present. The supporting findings are not always consistent (e.g., Hartley and Trueman, 1982) and they are based on a very limited sampling of text and subject populations.

Given that the only necessary distinction between overviews and summaries is their respective positions within a text, we might expect to find similar effects of summaries and overviews on reading and recall. The available research has focused solely upon the effects of summaries on text memory. All of the studies have employed summaries that abstract the main ideas of the text. When memory is assessed using forced-choice recognition procedures, the effects of summaries are inconsistent (Christensen and Stordahl, 1955; Parker, 1962). More recent investigations employing cued recall and free recall procedures consistently demonstrate better memory for texts with a concluding summary than for texts without summaries (Hartley *et al.*, 1979; Hartley and Trueman, 1982; McGlaughlin-Cook, 1981). Further, there is some evidence that the memory effects are selective. Specifically, Hartley and Trueman (1982) found the presence of a summary improved memory for main ideas included in the summary, but had no influence on memory for content not included in the summary. What is not clear is how summaries aid memory. It is unlikely summaries cause readers to more carefully process signaled information in the body of a text because a summary is encountered only after the rest of the text has been read. Of course, it is possible that readers look back through the text after reading a summary. Alternatively, readers may seek out a summary before reading the text and employ the summary as an overview. Three other hypotheses seem more plausible, however. One possibility is that summaries function as a retrieval plan which readers use to direct their search of memory when asked to recall text information. This assumes the topic structure representation that the reader constructs based on the body of the text is consistent with the representation presented in the summary (cf., Bransford and Johnson, 1972). A related possibility is that a summary represents a rehearsal of the text's main ideas (thus the selective influence on memory for main ideas). Finally, a summary may be a more comprehensible and coherent statement of the text's ideas than

was presented in the body of the text. This also would result in selectively better memory for main ideas (Reder and Anderson, 1980).

To conclude, summaries and overviews appear to have similar effects on text memory. This is not to suggest, however, the two signaling devices produce their effects on memory via the same mechanisms. Although they may operate in similar ways, their different locations in the text provide the opportunity for overviews and summaries to influence text memory via different mechanisms. Much more attention needs to be directed to the cognitive mechanisms by which overviews and summaries affect memory. In addition, research on summaries, in particular, needs to focus on effects besides those on memory. Summaries can help readers consolidate their understanding of difficult text material, but no investigations have attempted to separate effects on comprehension from effects on memory. Summaries might be employed systematically in text previewing strategies or as a basis for directing text look-backs. As is the case with titles, certain uses of summaries (e.g., journal abstracts) clearly are intended to allow readers to efficiently determine the relevance of a text to their needs. Research concerning these potential functions of summaries has yet to be done.

Typographical Cues

Perhaps the simplest way to signal the relevance of information is to distinguish it visually from the body of the text by typographical variation. There are many types of typographical cues, including underlining, boldface, italics, capitalization, color variation, and variation in spatial location. Typographical cues often are used redundantly with other types of signaling devices. For example, titles and headings usually are distinguished from the body of a text by their spatial positioning and typeface. Summaries sometimes are presented in italics or some alternative, distinctive typeface. However, typographical cues frequently are used as the sole means of cuing specific content within the body of a text. For example, topic sentences might be underlined or key words might be presented in boldface or italics.

Typographical cues differ in several ways from the signaling devices considered to this point. Typographical cues are very specific in their signaling function in two respects. Typographical cues are integral to the information they signal, so they are unambiguous with respect to the information they signal. Related to this, the scope of operation of a typographical cue is typically very narrow. A word or phrase or sentence is underlined or italicized. These attributes contrast with those of headings, for instance, where a given heading may operate on an entire chapter and the relation between the heading and specific statements in the chapter may vary from very direct

to very indirect or nonexistent. Finally, typographical cues directly signal text content (except when used redundantly with other signaling devices). That is, typographical cues are applied to specific words, phrases, or sentences within a text; thus they signal only the content of the words or sentences they distinguish. Of course, typographical cues may be used to indirectly signal the structure of a text by careful selection of phrases or sentences to be cued.

The majority of empirical studies have employed memory measures to assess effects of typographical cues. Various types of typographical cues have been investigated, including underlining (Cashen and Leicht, 1970; Coles and Foster, 1975; Crouse and Idstein, 1972; Glynn and DiVesta, 1979; Klare, *et al.*, 1955; Nist and Hogrebe, 1987; Proger *et al.*, 1973; Rickards and August, 1975), color variation (Fowler and Barker, 1974; Hershberger, 1964; Hershberger and Terry, 1965), and capitalization (Foster, 1979). There are not enough available data to suggest any differences in the effects of these different cues nor is there a good theoretical rationale for expecting differences; therefore, the three cuing devices will not be distinguished in my consideration of findings. Those findings may be summarized rather concisely. First, the most consistent finding is that typographical cuing improves memory for the signaled content (Cashen and Leicht, 1970; Coles and Foster, 1975, Exp. 3; Crouse and Idstein, 1972; Foster, 1979; Fowler and Barker, 1974; Glynn and DiVesta 1979; Hartley *et al.*, 1980; Hershberger and Terry, 1965; Nist and Hogrebe, 1987). Second, the memory benefits of typographical cues appear to be selective. Although memory for signaled content is improved, memory for unsignaled content is either unaffected (Foster, 1979), or inhibited (Glynn and DiVesta, 1979; Hershberger and Terry, 1965; Kulhavy, 1972) by the presence of typographical cues in a text [however, see Cashen and Leicht (1970) and Hartley *et al.* (1980) for exceptions to this general pattern].

The two conclusions presented above are well-supported. Other, more speculative conclusions may be suggested. Several failures to find benefits of typographical cues suggest possible boundary conditions on the effects of the signaling device. First, some studies failed to specifically test whether memory for signaled content was affected by typographical cues (Fowler and Barker, 1974, Exp. 1; Rickards and August, 1975). Thus, a selective effect of cuing may have been obscured by the global performance measures employed in those experiments. Second, most studies have at least produced trends in the direction of better memory for cued information, with two exceptions. Two studies have examined complex typographical cuing schemes in which four or five categories of text content have been signaled by different combinations of cues (color variation, typeface variation, and underlining). Although the trends were not always reliable, the studies found poorer memory for both signaled and unsignaled content if typographical cues were

present in the text (Hershberger, 1964; Hershberger and Terry, 1965). Thus, typographical cuing may be beneficial only if the nature of the cuing is simple enough for the reader to readily grasp the relationship between the cues and the text content. Finally, one common denominator of all of the studies failing to demonstrate benefits of typographical cues is that the experimental text included a relatively high proportion of cued content. The lowest proportion of cued content was 10% of the words in texts approximately 200 words in length (Crouse and Idstein, 1972, Exp. 1); the amount of text content cued in the remaining studies ranged from 17-46% (Coles and Foster, 1975, Exp. 1 and 2; Fowler and Barker, 1974, Exp. 1; Hershberger, 1964; Hershberger and Terry, 1965; Klare *et al.*, 1955; Rickards and August, 1975). The proportion of cued material might be expected to influence the effectiveness of the cue because the distinctiveness of the cued information decreases as the proportion of cued content increases (cf., Wallace, 1965). It should be noted, however, that a high proportion of cued content cannot be the sole reason signaling effects were not observed in some experiments; signaling effects have been demonstrated with the proportion of cued content as high as 46% (Coles and Foster, 1975, Exp. 3).

Although there have been many studies of typographical cuing effects on memory, there are few investigations of potential effects on other cognitive mechanisms. There certainly are reasons to expect effects of typographical cues on processes of attention, comprehension, and selective access. Typographical cues cause the content they signal to be visually distinct from the rest of the text. Thus, they can be expected to be an efficient basis for directing attention. In fact, cuing effects on memory frequently have been explained as due to mediating effects on attention (e.g., Crouse and Idstein, 1970; Foster, 1979; Glynn, 1978). This is a reasonable hypothesis, but it is untested.

Another candidate as a mediator of memory effects are processes underlying comprehension. A reader must identify important text content and determine relations among text topics during the course of trying to comprehend a text. If typographical cues signal text topics and important predications about those topics, the reader may process the "gist" of the text more efficiently and effectively. This, in turn, would aid subsequent recall of the signaled information. There is some evidence that the use of italics to signal key words can effectively direct a reader's attention to one potential interpretation of an ambiguous text (Pratt *et al.*, 1981).⁵

⁵Pratt *et al.* (1981) used a forced-choice recognition task to assess signaling effects, but the effects they observed do not appear attributable to memory. Each question in their test had four alternatives, two of which were correct choices. The two correct choices were consistent with the alternative interpretations of the text. Subjects rarely chose a distractor, indicating no difficulty remembering relevant information. Rather, subjects' choices of correct responses were biased strongly toward the interpretation consistent with the signaling in the text.

Finally, typographical cues can be expected to influence text search processes. Because typographical cues visually distinguish text content, they provide a simple mechanism for directing a search for specific information in a text. A study by Frase and Schwartz (1979) demonstrates readers' search for information within a brief technical text is speeded by the use of spatial cues (segmentation and indentation) to distinguish meaningful units of text. It is of interest to know whether similar effects occur with the use of typographical cuing devices that do not disrupt the normal sentence and paragraph structure of printed text.

Other Findings

In this section, I will consider several studies which do not fall within the categories of signaling devices reviewed thus far.

Recall Sentences

One way in which an author may signal relations between two separate parts of a text is by the use of recall sentences. For example, an appropriate recall sentence in the present context might be: "Recall that we discussed preview sentences in an earlier section; recall sentences function similarly to preview sentences except that they follow, rather than precede, the information they signal." The only current investigation of recall sentences is by Glover *et al.* (1988). In that study, readers were presented a two-chapter text in which recall sentences were present in half of the paragraphs of the second chapter. The recall sentences made explicit a relationship between the paragraph in which it was embedded and a paragraph in the first chapter. There were several effects of the recall sentences: More time was devoted to reading paragraphs that began with recall sentences than paragraphs not containing recall sentences. Further, both free recall and cued recall of signaled content were better than recall of unsignaled content. Finally, content from parallel paragraphs in the two chapters of the text clustered more in recall if the relation between the paragraphs was signaled rather than unsignaled. These findings suggest recall sentences induce readers to attend more to the content of, and relations between, signaled paragraphs. As a consequence, the signaled information is better organized and better remembered than unsignaled content.

Number Signals

One effective way to indicate the organization of information in an expository text is to number distinct parts of the text. This may be done either

with numerals (1, 2, 3, etc.) or with words (e.g., first, second, finally). Numbering should aid memory for signaled content both by indicating the relevance of the associated content and by providing an explicit statement of the organization of the content. There are several demonstrations that numbering does improve memory for signaled information (Goldman, 1988; Lorch, 1985; Lorch and Chen, 1986). The Lorch and Chen investigation suggests how numbering influences recall. Lorch and Chen found readers processed sentences more slowly if the sentences were signaled by numbers. Further, information was free-recalled better (although cued recall was unaffected) and organized more according to the organization of the text if it was signaled. These findings suggest number signals cause readers to attend more to the organization of signaled information, with the result that readers have an effective plan for retrieving the signaled information at recall.

Function and Relevance Indicators

A variety of pointer words or phrases may be used to direct attention to important content in a text. For example, an author may emphasize the relevance of a statement by preceding it with a phrase such as, "It is important to note that . . ." An author may make explicit the function of a statement or paragraph with phrases such as, "In summary," or "Let me conclude by . . ." Signaling devices such as these may be expected to aid memory for the specific content they emphasize. There is some evidence that summary and importance indicators do induce better memory for signaled content (Lorch and Lorch, 1986). Further, the better memory associated with the use of summary indicators appears to be mediated by effects on attention. Specifically, the presence of a summary indicator causes readers to read the signaled content more slowly than they otherwise would (Lorch and Lorch, 1986).

Use of Signaling Devices to Influence Reading Strategies

There is substantial evidence that various signaling devices have selective effects on readers' processing and recall of text. Mayer and his colleagues (Loman and Mayer, 1983; Mayer *et al.*, 1984) and Meyer and her colleagues (Meyer *et al.*, 1982) have exploited this property of signals in an attempt to influence readers' strategies for processing text. Mayer carefully analyzed scientific texts to identify conceptual content conveying the major concepts and their relations. He then employed combinations of signaling devices to emphasize the conceptual content. Although the presence of signaling had no effects on the recognition of facts or verbatim statements from the experimental texts, signals did produce better free recall of conceptual content

and better solutions to problems based on the text (Loman and Mayer, 1983; Mayer *et al.*, 1984). Thus, signaling led readers to construct a better representation of the scientific model conveyed in the text with the result that they were better able to employ the model to solve relevant problems. These studies are notable particularly as the only available investigations of signaling effects on comprehension not relying solely on memory tasks.

Meyer also has used combinations of signaling devices to emphasize the superordinate structure of expository text. There is some evidence this manipulation leads to a more coherent representation of superordinate structure by readers who otherwise would not represent text structure effectively (Meyer *et al.*, 1980). Signals also may be used to influence readers' representations of a text with two alternative organizations. The effect on readers' organization of text information, in turn, affects the distribution of information recalled from the text (Meyer and Rice, 1982).

In sum, the studies by Mayer and by Meyer suggest that judicious use of signals can have qualitative effects on readers' representations of text. These studies indicate an important direction for future research on signaling devices.

FINAL CONSIDERATIONS

This review has focused on the general question of how signaling devices influence cognitive processes associated with reading. Table III indicates the nature of the investigations of signaling; Table IV summarizes the results of those investigations. The most obvious conclusion from Table III is there are large gaps in our study of signaling effects. Although effects on memory have been demonstrated for every type of signaling device studied, effects on attention, reading processes, comprehension, and search are relatively un-

Table III. Cognitive Processes for Which Signaling Effects Have Been Demonstrated^a

Type of signal	Locus of Effect				
	Attention	Reading	Comprehension	Memory	Search
Titles	—	—	Yes	Yes	—
Headings	—	—	—	Yes	Yes
Previews	Yes	—	—	Yes	—
Overviews	—	Yes	—	Yes	—
Summaries	—	—	—	Yes	—
Typography	—	—	Yes	Yes	Yes
Recall Sentences	Yes	—	—	Yes	—
Enumeration	Yes	—	—	Yes	—
Relevance Indicators	No	—	—	Yes	—
Function Indicators	Yes	—	—	Yes	—

^a“Yes” means that an effect has been demonstrated; “no” means that an attempt to demonstrate an effect yielded null results; “—” means no relevant investigations have been reported.

Table IV. Summary of Effects of Signals on Reading and Memory Processes

Locus of Effect	Effects
<u>Memory</u>	
Titles	<ol style="list-style-type: none"> 1. If referents in text are vague, a title produces better overall recall. 2. If referents in text are clear, a title produces selectively better memory for title-relevant information and poorer memory for irrelevant information.
Headings	<ol style="list-style-type: none"> 1. Better memory for heading-relevant information; fate of heading-irrelevant information unclear.
Previews	<ol style="list-style-type: none"> 1. Better memory for signaled than unsigned information.^a 2. Clustering of associated information when relation is signaled.
Overviews	<ol style="list-style-type: none"> 1. When text organization is not obvious, better overall recall results. 2. When text organization is clear, better memory for signaled information (no effect unsigned information).
Summaries	<ol style="list-style-type: none"> 1. Better memory for information in summaries; effects on unsigned information are unclear.
Typography	<ol style="list-style-type: none"> 1. Better memory for signaled information; no effect or worse memory for unsigned information.
Reviews	<ol style="list-style-type: none"> 1. Better memory for signaled than unsigned information.^a 2. Clustering of associated information when the relation is signaled.
Enumeration	<ol style="list-style-type: none"> 1. Better recall of signaled information; fate of unsigned information unknown. 2. Better organization of signaled information in recall.
Pointer words	<ol style="list-style-type: none"> 1. Better recall of signaled information; fate of unsigned information unknown.
<u>Attention</u>	
Previews	<ol style="list-style-type: none"> 1. More attention to signaled than unsigned text.^a
Reviews	<ol style="list-style-type: none"> 1. More attention to signaled than unsigned text.^a
Enumeration	<ol style="list-style-type: none"> 1. More attention to a sentence if signaled.
Pointer words	<ol style="list-style-type: none"> 1. More attention to a sentence if signaled as a summary.
<u>Reading</u>	
Overviews	<ol style="list-style-type: none"> 1. Topic-introducing sentences are read faster if an overview of topics is included in the text.
<u>Comprehension</u>	
Titles	<ol style="list-style-type: none"> 1. Readers' perceptions of the appropriate organization of sentences in a text are influenced by title.
Typography	<ol style="list-style-type: none"> 1. Signaling of key words can bias the interpretation of an ambiguous text.
<u>Search</u>	
Headings	<ol style="list-style-type: none"> 1. Answers to specific questions are located faster if headings are present.
Typography	<ol style="list-style-type: none"> 1. Answers to specific questions are located faster if text segmented into clausal units.

^aThe Glover *et al.* study (1988) compared processing of signaled vs. unsigned information in a within-subjects design. No control condition was included in which readers received a text without any signals. Thus, it is not possible to determine whether the difference in performance on signaled vs. unsigned information reflects better memory (or more attention) for signaled text, or poorer memory (less attention) for unsigned text, or both effects.

examined. There are several important reasons for pursuing research in these areas. First, a more complete understanding of the effects of each signaling device will permit the identification of similarities and differences in the operation of different devices. Second, better understanding of how signaling devices function will lead to better understanding of reading processes in general. Third, better models of the cognitive effects of signals have relevance to reading instruction.

Potential Dimensions of Variation Across Signaling Devices

Signals represent a very diverse collection of writing devices. There are good reasons to expect different signaling devices will influence cognition differently. There also are plausible reasons to expect similar effects of devices appearing to be very different. For example, it may well be the case that all signaling devices cause more attention to be paid to the cued text. Most interesting, however, is the possibility that the collection of devices presented in Table I may be ordered with respect to a few dimensions which may account for similarities and differences in their effects.

One dimension along which signals vary is in what they signal. Some signals typically cue only text content (e.g., titles, typography); other signals explicitly mark aspects of organization (e.g., enumeration); many signals cue both content and organization (e.g., headings, overviews). It is reasonable to expect that cuing organization may have different effects than cuing only content. The most obvious hypothesis is that content cues may have no effect on how readers represent aspects of text organization, whereas organization signals are known to have such effects (Glover *et al.*, 1988; Lorch and Chen, 1986).

A second source of variation in signaling devices is in the scope of their operation. Some signals cue information across large sections of text (e.g., titles, headings, overviews), whereas other signals often cue only sentences (e.g., relevance indicators) or words (e.g., typographical cues). It might be the case, for instance, that signals with narrow scopes have only very selective effects on memory, whereas signals with broad scopes are more likely to have general effects on memory. There is some tentative support for this speculation in the comparison of effects of typographical cues with the effects of titles, headings, and overviews (see Table IV). It is important that future studies of signaling attempt to distinguish signaled and un signaled text, and examine signaling effects separately for the two types of information.

Covarying with scope is what might be called the "clarity" of a signal. That is, signals with narrow scopes are unambiguous in their designation of cued information (e.g., the underlined word is the relevant information); whereas it is often more difficult to determine whether a given statement in

a text is cued by a signal with a broad scope (e.g., the relation between a title and a given sentence in text can be very indirect). Perhaps signals clearly indicating relevant information have more consistent and robust effects than signals that are less direct in their designation of relevant information.

Finally, some signals are visually distinctive (e.g., typographical cues), whereas others are not (e.g., previews and pointer words). It seems likely that only visually distinctive cues can effectively direct reading strategies that rely on selective search of text.

These four possible dimensions of variation among signaling devices are purely speculative at this point. Future research will determine the usefulness of categorizing signals along these dimensions.

The Relevance of Models of Signaling Effects to Theory and Application

Previous investigations have relied extensively on memory measures of signaling effects. The result is we are greatly restricted both in theorizing about the basis of signaling effects and in attempting to apply the empirical findings. Information about how signals influence attention, search, and reading processes will lead to better understanding not only of how signals affect memory, but of reading processes in general. Further, models of how specific signaling devices influence processes during reading should be of value to reading instruction. To illustrate both these claims, consider a specific example.

Number signals appear to influence mature readers' subsequent free recalls of text content by three mechanisms (Lorch and Chen, 1986): The presence of numbers in a text causes readers to carefully attend to the cued information. The explicit marking of the organization of the signaled information leads readers to represent that organization explicitly in memory. At the time of recall, the organized representation constructed during reading serves as a retrieval plan to guide recall of the associated text content. This model incorporates abilities (i.e., selective attention, representation of organization, use of retrieval plans) that are general to the reading process rather than specific to signaling effects. Thus, an understanding of how number signals influence cognitive processes may illuminate the reading process more generally. Further, the model has application to issues of reading instruction and individual differences. Specifically, it identifies three cognitive processes that must occur if the signaling device is to facilitate performance on the outcome measure (i.e., free recall): (1) the reader must note the relevance of the signal and attend to the cued information; (2) the reader must represent the organization signaled by the numbers; (3) the reader must know to use the representation of the organization to guide recall. These activities are quite distinct and almost certainly entail different cognitive

knowledge and abilities. The implication is that readers must learn all three component abilities if they are to effectively respond to number signals.

In conclusion, although much attention has been directed to the effects of various signaling devices on memory, less is known about how memory effects may be mediated by signaling effects on attention, reading processes, and comprehension. Research focusing on these questions promises to advance both reading theory and reading instruction.

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REFERENCES

- Bock, M. (1980). Some effects of titles on building and recalling text structures. *Discourse Processes* 3: 301-311.
- Bransford, J. D., and Johnson, M. K. (1972). Contextual prerequisites for understanding. *J. Verb. Learn. Verb. Behav.* 11: 717-726.
- Britton, B. K., Glynn, S. M., Meyer, B. J. F., and Penland, M. J. (1982). Effects of text structure on use of cognitive capacity during reading. *J. Educat. Psychol.* 74: 51-61.
- Brooks, L. W., Dansereau, D. F., Spurlin, J. E., and Holley, C. D. (1983). Effects of headings on text processing. *J. Educat. Psychol.* 75: 292-302.
- Cashen, V. M., and Leicht, K. L. (1970). Role of the isolation effect in a formal educational setting. *J. Educat. Psychol.* 61: 484-486.
- Christensen, C. M., and Stordahl, K. E. (1955). The effect of organization aids on comprehension and retention. *J. Educat. Psychol.* 46: 65-74.
- Coles, P., and Foster, J. (1975). Typographic cueing as an aid to learning from typewritten text. *Prog. Learn. Educat. Tech.* 12: 102-108.
- Crouse, J. H., and Idstein, P. (1972). Effects of encoding cues on prose learning. *J. Educat. Psychol.* 63: 309-313.
- Dee-Lucas, D., and DiVesta, F. J. (1980). Learner-generated organizational aids: Effects on learning from text. *J. Educat. Psychol.* 72: 304-311.
- van Dijk, T. A. (1979). Relevance assignment in discourse comprehension. *Discourse Processes* 2: 113-126.
- Doctorow, M., Wittrock, M. C., and Marks, C. (1978). Generative processes in reading comprehension. *J. Educat. Psychol.* 70: 109-118.
- Dooling, D. J., and Lachman, R. (1971). Effects of comprehension on retention of prose. *J. Exper. Psychol.* 88: 216-222.
- Dooling, D. J., and Mullet, R. L. (1973). Locus of thematic effects in retention of prose. *J. Exper. Psychol.* 97: 404-406.
- Foster, J. J. (1979). The use of visual cues in text. In Kolers, P. A., Wrolstad, M. E. and Bouma H., (eds.), *Processing of Visible Language*, Vol. 1, Plenum Press, New York, pp. 189-203.
- Fowler, R. L., and Barker, A. S. (1974). Effectiveness of highlighting for retention of text material. *J. Appl. Psychol.* 59: 358-364.
- Frase, L. T. (1969). Paragraph organization of written materials: The influence of conceptual clustering upon the level and organization of recall. *J. Educat. Psychol.* 60: 394-401.

- Frase, L. T., and Schwartz, B. J. (1979). Typographical cues that facilitate comprehension. *J. Educat. Psychol.* 71: 197-206.
- Glover, J. A., Dinnel, D. L., Halpain, D. R., McKee, T. K., Corkill, A. J., and Wise, S. L. (1988). Effects of across-chapter signals on recall of text. *J. Educat. Psychol.* 80: 3-15.
- Glynn, S. M. (1978). Capturing readers' attention by means of typographical cuing strategies. *Educat. Technol.* 18: 7-12.
- Glynn, S. M., and DiVesta, F. J. (1979). Control of prose processing via instructional and typographical cues. *J. Educat. Psychol.* 71: 595-603.
- Goetz, E. T., Alexander, P. A., and Schallert, D. L. (1987). The author's role in cueing strategic processing of college textbooks. *Red. Res. Instruct.* 27: 1-11.
- Goldman, S. R. (1988). *Strategies for Understanding Information Organization in Discourse*, paper presented at the Psychonomics Society Convention, Chicago.
- Guthrie, J. T. (1988). Locating information in documents: Examination of a cognitive model. *Read. Res. Quart.* 23: 178-199.
- Hartley, J., Bartlett, S., and Branthwaite, A. (1980). Underlining can make a difference—sometimes. *J. Educat. Res.* 73: 218-224.
- Hartley, J., Goldie, M., and Steen, L. (1979). The role and position of summaries: Some issues and data. *Educat. Rev.* 31: 59-65.
- Hartley, J., Kenely, J., Owen, G., and Trueman, M. (1980). The effect of headings on children's recall from prose text. *Brit. J. Educat. Psychol.* 5: 304-307.
- Hartley, J., Morris, P., and Trueman, M. (1981). Headings in text. *Remed. Educat.* 16: 5-7.
- Hartley, J., and Trueman, M. (1982). The effects of summaries on the recall of information from prose: Five experimental studies. *Human Learn* 1: 63-82.
- Hartley, J., and Trueman, M. (1985). A research strategy for text designers: The role of headings. *Instruct. Sci.* 14: 99-155.
- Hershberger, W. (1964). Self-evaluational responding and typographical cueing: Techniques for programing self-instructional reading materials. *J. Educat. Psychol.* 55: 288-296.
- Hershberger, W., and Terry, D. F. (1965). Typographical cuing in conventional and programmed texts. *J. Appl. Psychol.* 49: 55-60.
- Holley, C. D., Dansereau, D. F., Evans, S. H., Collins, K. W., Brooks, L., and Larson, D. (1981). Utilizing intact and embedded headings as processing aids with nonnarrative text. *Contemp. Educat. Psychol.* 6: 227-236.
- Idstein, P., and Jenkins, J. R. (1972). Underlining versus repetitive reading. *J. Educat. Res.* 65: 321-323.
- Kintsch, W., and van Dijk, T. A. (1978). Toward a model of discourse comprehension and production. *Psychol. Rev.* 85: 363-394.
- Kirsch, I. S., and Guthrie, J. T. (1984). Prose comprehension and text search as a function of reading volume. *Read. Res. Quart.* 19: 331-342.
- Klare, G. R., Mabry, J. E., and Gustafson, L. M. (1955). The relationship of patterning (underlining) to immediate retention and to acceptability of technical material. *J. Appl. Psychol.* 39: 40-42.
- Klare, G. R., Shuford, E. H., and Nichols, W. H. (1958). The relation of format organization to learning. *Educat. Res. Bull.* 37: 39-45.
- Kozminsky, E. (1977). Altering comprehension: The effect of biasing titles on text comprehension. *Mem. Cognit.* 5: 482-490.
- Kulhavy, R. W. (1972). Effects of embedding orienting stimuli in a prose passage. *Psychonom. Sci.* 28: 213-214.
- Loman, N. L., and Mayer, R. E. (1983). Signaling techniques that increase the understandability of expository prose. *J. Educat. Psychol.* 75: 402-412.
- Lorch, R. F., Jr. (1985). Effects on recall of signals to text organization. *Bull. Psychonom. Soc.* 23: 374-376.
- Lorch, R. F., Jr., and Chen, A. H. (1986). Effects of number signals on reading and recall. *J. Educat. Psychol.* 78: 263-270.
- Lorch, R. F., Jr., and Lorch, E. P. (1985). Topic structure representation and text recall. *J. Educat. Psychol.* 77: 137-148.
- Lorch, R. F., Jr., and Lorch, E. P. (1986). On-line processing of summary and important signals in reading. *Discourse Processes* 9: 489-496.

- Lorch, R. F., Jr., Lorch, E. P., and Matthews, P. D. (1985). On-line processing of the topic structure of a text. *J. Mem. Lang.* 24: 350-362.
- Mayer, R. E. (1984). Aids to text comprehension. *Educ. Psychol.* 19: 30-42.
- Mayer, R. E., Dyck, L. K., and Cook, J. L. (1984). Techniques that help readers build mental models from scientific text: Definitions pretraining and signaling. *J. Educat. Psychol.* 76: 1089-1105.
- McLaughlin-Cook, N. (1981). Summaries: Further issues and data. *Educ. Rev.* 33: 215-222.
- Meyer, B. J. F. (1975). *The Organization of Prose and Its Effects on Memory*, Elsevier, New York.
- Meyer, B. J. F., Brandt, D. M., and Bluth, G. J. (1980). Use of top-level structure in text: Key for reading comprehension of ninth-grade students. *Read. Res. Quart.* 16: 72-103.
- Meyer, B. J. F., and Rice, E. (1982). The interaction of reader strategies and the organization of text. *Text* 2: 155-192.
- Nist, S. L., and Hogrebe, M. C. (1987). The role of underlining and annotating in remembering textual information. *Read. Res. Instruct.* 27: 12-25.
- Parker, J. P. (1962). Some organizational aids and their effect upon comprehension. *J. Commun.* 12: 27-32.
- Pratt, M. W., Krane, A. R., and Kendall, J. R. (1981). Triggering a schema: The role of italics and intonation in the interpretation of ambiguous discourse. *Am. Educat. Res. J.* 18: 303-315.
- Proger, B. B., Carter, C. E., Jr., Mann, L., Taylor, R. G., Jr., Bayuk, R. J., Jr., Morris, V. R., and Reckless, D. E., (1973). Advance and concurrent organizers for detailed verbal passages used with elementary school pupils. *J. Educat. Res.* 66: 451-456.
- Reder, L. M., and Anderson, J. R. (1980). A comparison of texts and their summaries: Memorial consequences. *J. Verb. Learn. Verb. Behav.* 19: 121-134.
- Rickards, J. P., and August, G. J. (1975). Generative underling strategies in prose recall. *J. Educat. Psychol.* 67: 860-865.
- Schallert, D. L. (1976). Improving memory for prose: The relationship between depth of processing and context. *J. Verb. Learn. Verb. Behav.* 15: 621-632.
- Spyridakis, J. H., and Standal, T. C. (1986). Headings, previews, logical connectives: Effects on reading comprehension. *J. Tech. Writing Commun.* 16: 343-354.
- Spyridakis, J. H., and Standal, T. C. (1987). Signals in expository prose: Effects on reading. *Read. Res. Quart.* 22: 285-298.
- Wallace, W. P. (1965). Review of the historical, empirical, and theoretical status of the von Restorff phenomenon. *Psychol. Bull.* 63z: 410-424.
- Waller, R. H. W. (1979). Typographic access structures for educational texts. In Kolers, P. A. Wrolstad, M. E. and Bouma, H. (eds.), *Processing of Visible Language*, Vol. 1, Plenum Press, New York, pp. 175-188.
- Waller, R. H. W. (1980). Graphic aspects of complex texts: Typography as macro-punctuation. In Kolers, P. A. Wrolstad, M. W. and Bouma, H. (eds.), *Processing of Visible Language*, Vol. 2, Plenum Press, New York, pp. 242-253.
- Wilhite, S. C. (1986). The relationship of headings, questions, and locus of control to multiple-choice test performance. *J. Read. Behav.* 18: 23-39.
- Yuill, N., and Joscelyne, T. (1988). Effect of organizational cues and strategies on good and poor comprehenders' story understanding. *J. Educat. Psychol.* 80: 152-158.